

DISTRIBUTION OF *NEOSCORPIOPS* SCORPIONS IN THE WESTERN GHATS OF MAHARASHTRA AND GUJARAT AND POSSIBLE TRICHOBOTHRIDIAL VARIATIONS AMONG ISOLATED POPULATIONS¹

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(With forty seven text-figures)

INTRODUCTION

Though the placement of the subfamily Scorpiopsinae under family Vaejovidae is doubtful (Stahanke 1974, Francke 1976) so far all Southeast Asian *Scorpiops* are placed under the same family Vaejovidae. The subfamily Scorpiopsinae comprises three genera, namely 1. *Scorpiops* Peters (1861), 2. *Parascorpiops* Banks (1928) and 3. *Dasyscorpiops* Vachon (1973). Francke (1976) doubted the taxonomic validity of the latter two and suggested that they be lowered to subgeneric rank under *Scorpiops*. He also suggested the revision of the taxonomic status of the sub-family Scorpiopsinae itself. Recently Kovarik (1995) raised the sub-family Scorpiopsinae to the rank of family Scorpiosinidae and included all the species known from SE Asia under this family. The genus *Scorpiops* represents a vast distribution right from Afghanistan to Burma through the Great Himalaya and at some places in Satpura and western ghats in south India (Bastawade 1992). This genus comprises 15 species and 7 subspecies nominated so far from India. Whereas the remaining two genera are monotypic and so far known to occur only at one place each as *Parascorpiops* from Borneo, Indonesia and *Dasyscorpiops* from Malacca, Malaysia (Francke 1976).

The major genus *Scorpiops* Peters has been revised and divided into four sub-genera, namely i. *Scorpiops* Vachon (Nominal), ii. *Neoscorpiops* Vachon, iii. *Euscorpiops* Vachon and iv. *Alloscorpiops* Vachon (Vachon 1980). Among these, except *Neoscorpiops*, the remaining three have been

commonly reported from the Indian Himalayan ranges, right from Kashmir to Arunachal Pradesh. However, the sub-genus *Euscorpiops* is observed to restrict itself to the North Eastern portion of India, Bangladesh, Bhutan and Burma (Bastawade 1992) and the sub-genus *Alloscorpiops* to Burma only (Francke 1976). The sub-genus *Scorpiops* (Nominal) is widely distributed throughout the Himalayas and also at certain places in Satpura such as Pachmarhi, Madhya Pradesh (Bastawade 1992), (See Fig. 1 & 2). The subgenus *Neoscorpiops* shows restricted distribution through the Western Ghats in Maharashtra and Gujarat (some data unpublished). This subgenus is so far known to comprise only three nominate species viz. 1. *Scorpiops* (*Neoscorpiops*) *satarensis* Pocock (1900) (Mahabaleshwar, Satara), 2. *S. (N.) deccanensis* Tikader and Bastawade (1976) (Sinhagad, Pune) and 3. *S. (N.) tenuiacauda* Pocock (1900) (Matheran, Raigad). These species occur in three adjacent districts in the state of Maharashtra (Fig. 2).

After Fauna of India: Scorpions (Tikader and Bastawade 1983), I undertook an extensive survey of the Western Ghats for the collection of Scorpions during 1984-87. The intense effort of these surveys made it possible to collect Scorpiosinid Scorpions from as many as 20 new localities in Western Ghats in different districts (Bastawade 1986, 1987). The collection areas spread over 6 districts between Tapi and Koyana valleys of Maharashtra. The only district in Gujarat state from which these Scorpions are reported is Dangs, which also falls to the south of Tapi Valley. The records of this family from Dhulia, Nasik, Thane districts in Maharashtra and Dangs in Gujarat are new.

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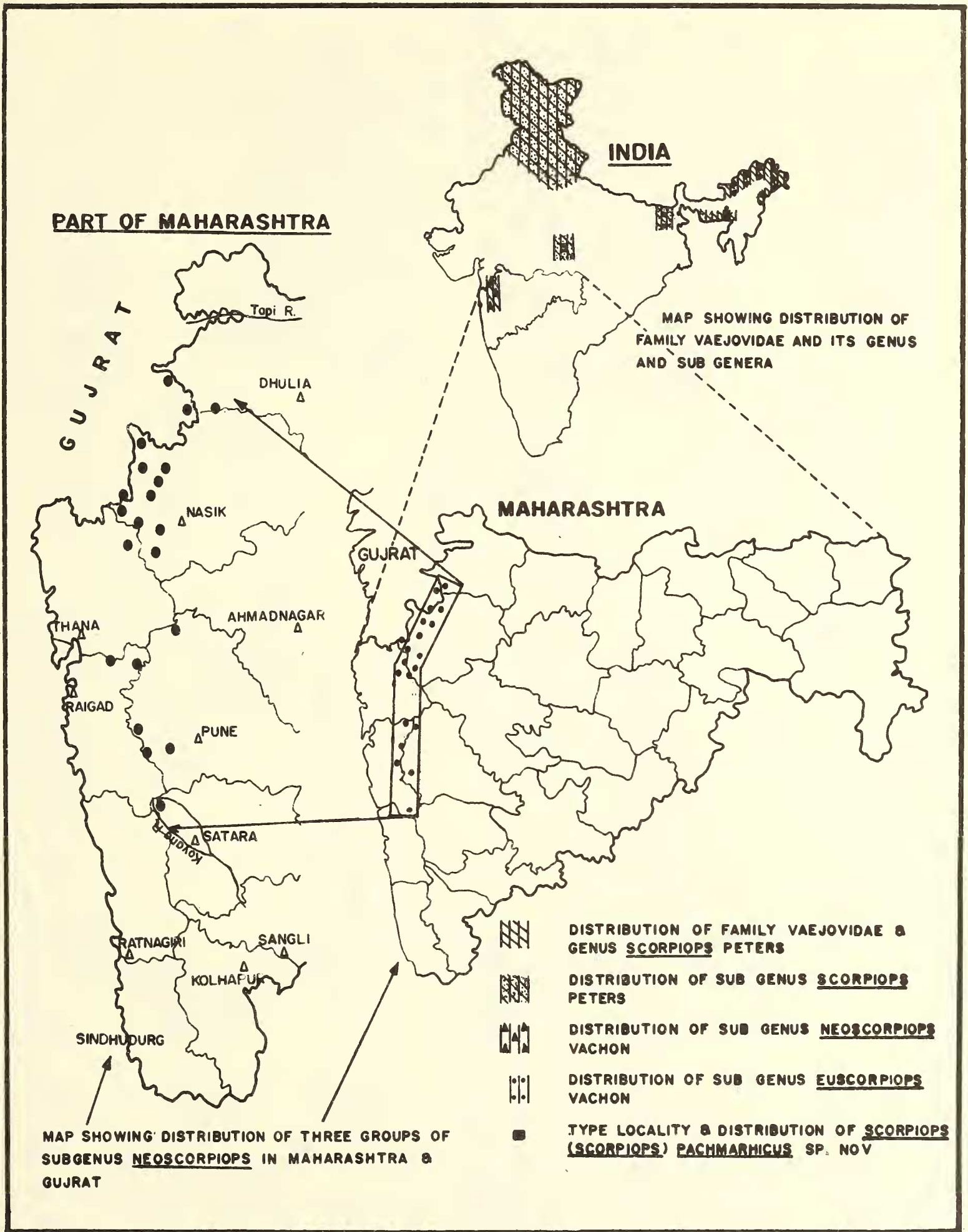
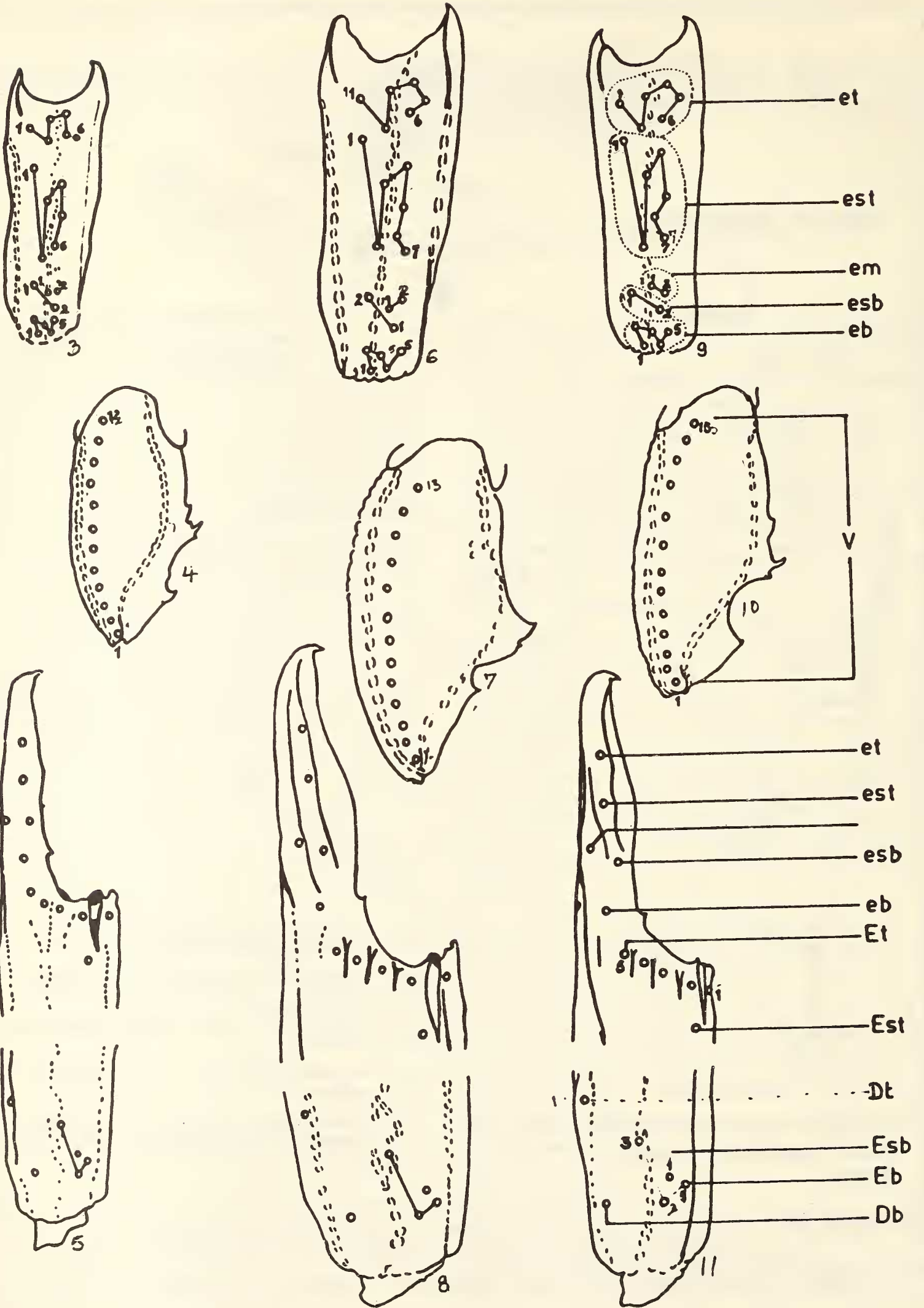
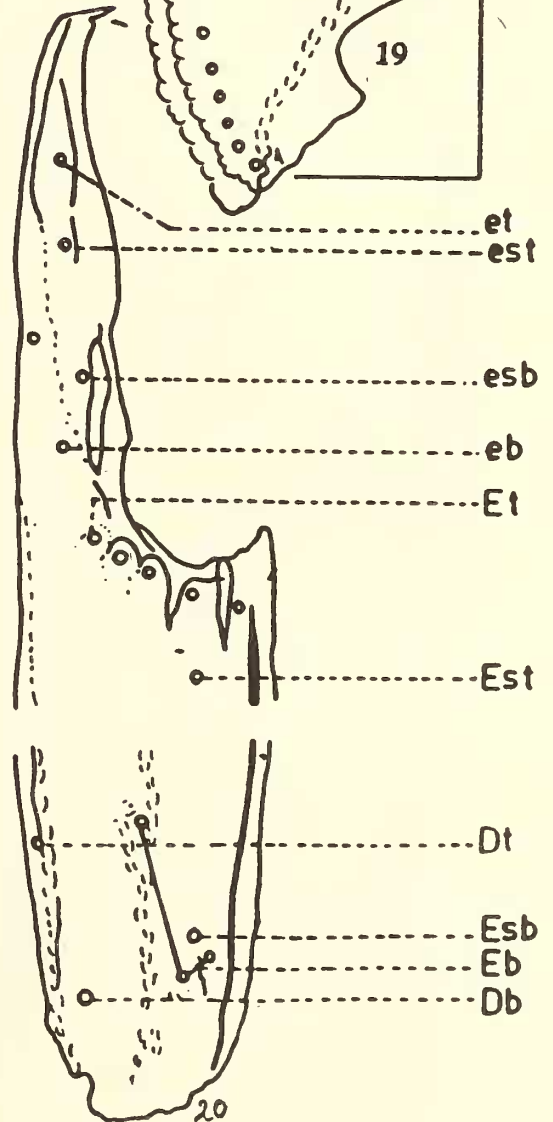
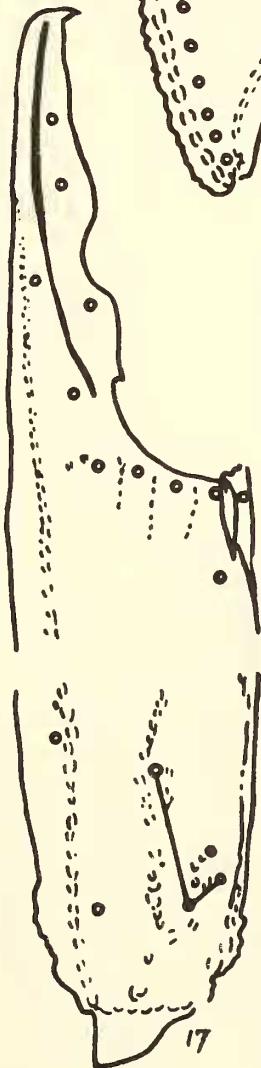
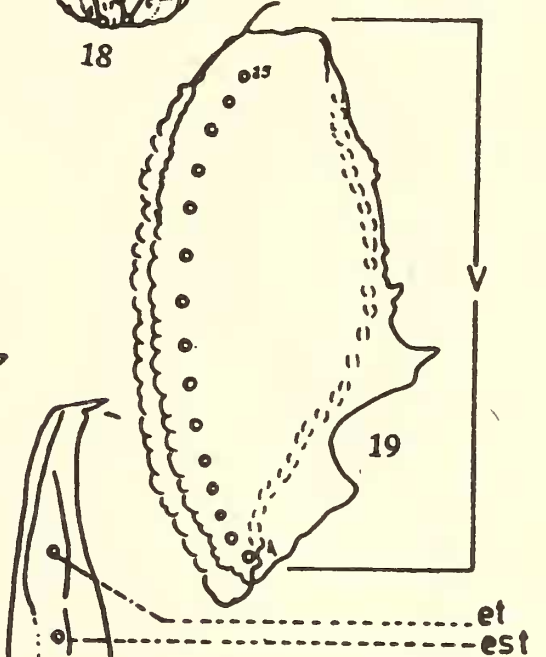
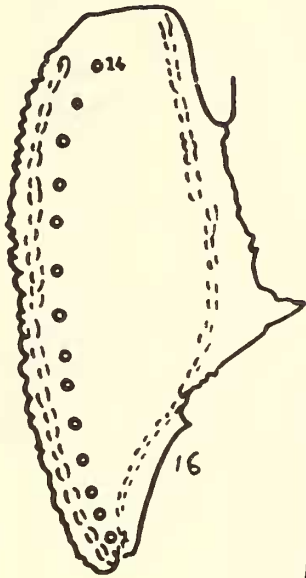
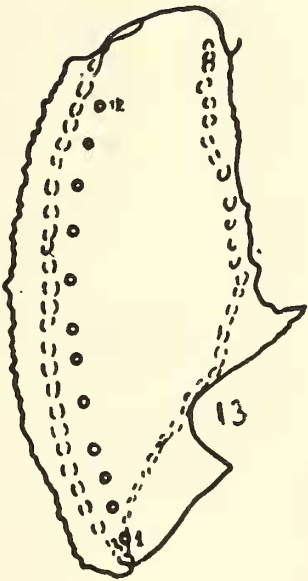
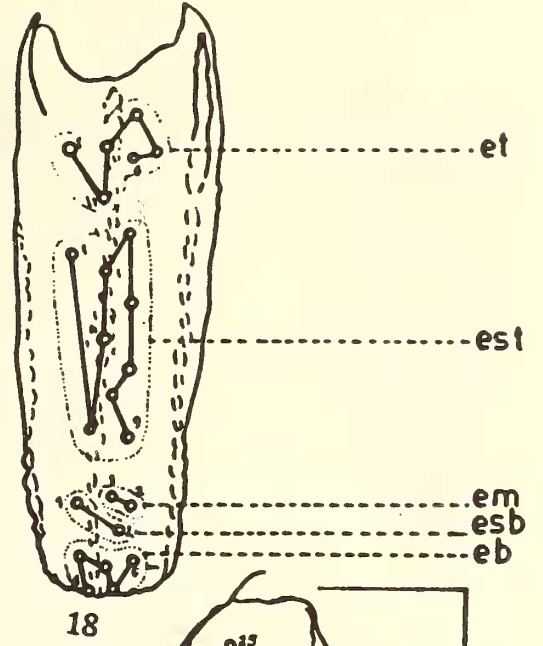
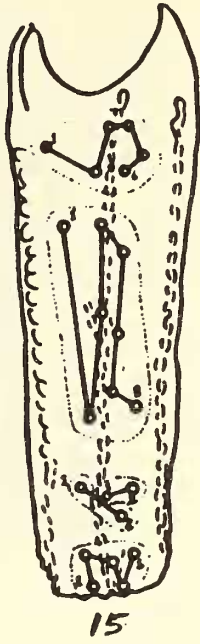
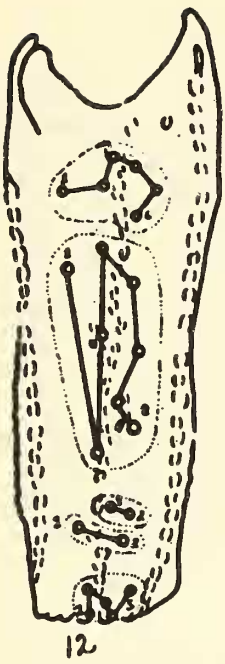
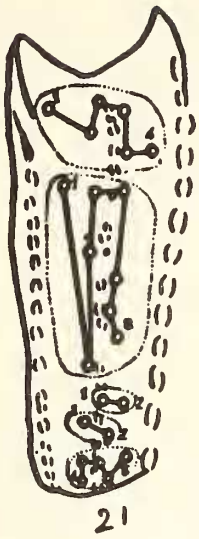


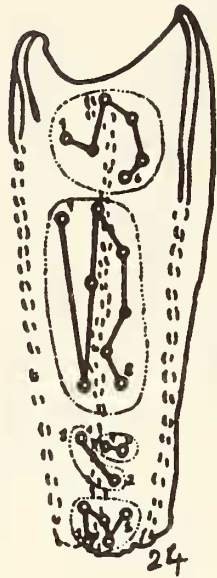
Fig. 1. Showing distribution of family Scorpiopsinidae and its genera and subgenera;
 2. Showing distribution of three groups of subgenus *Neoscorpiops* in Maharashtra and Gujarat



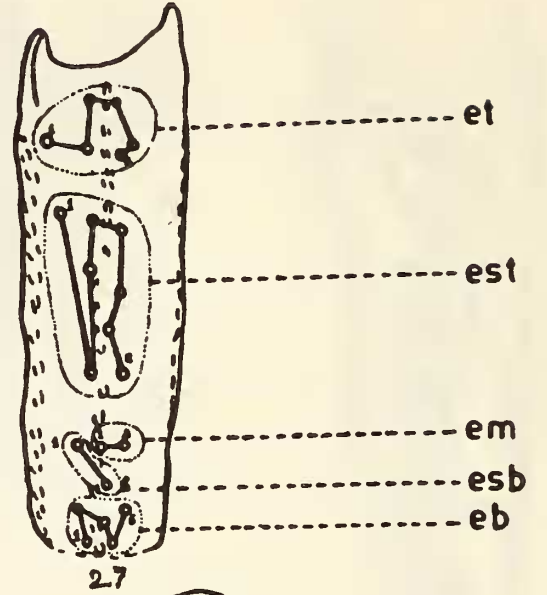




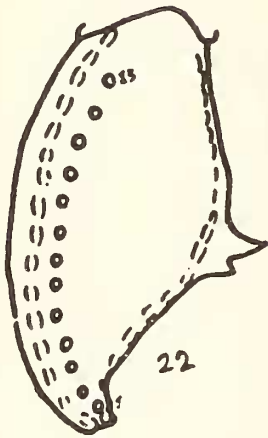
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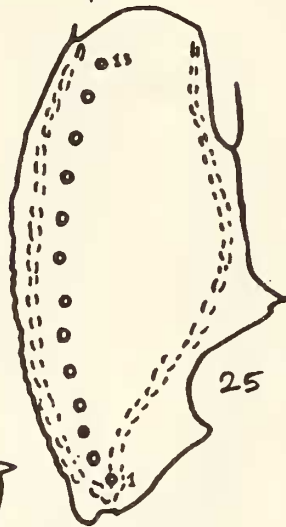
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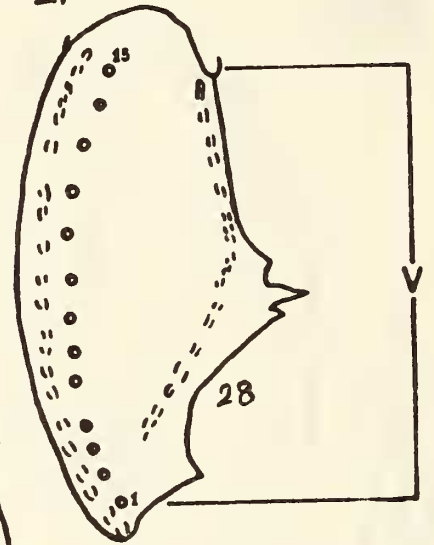
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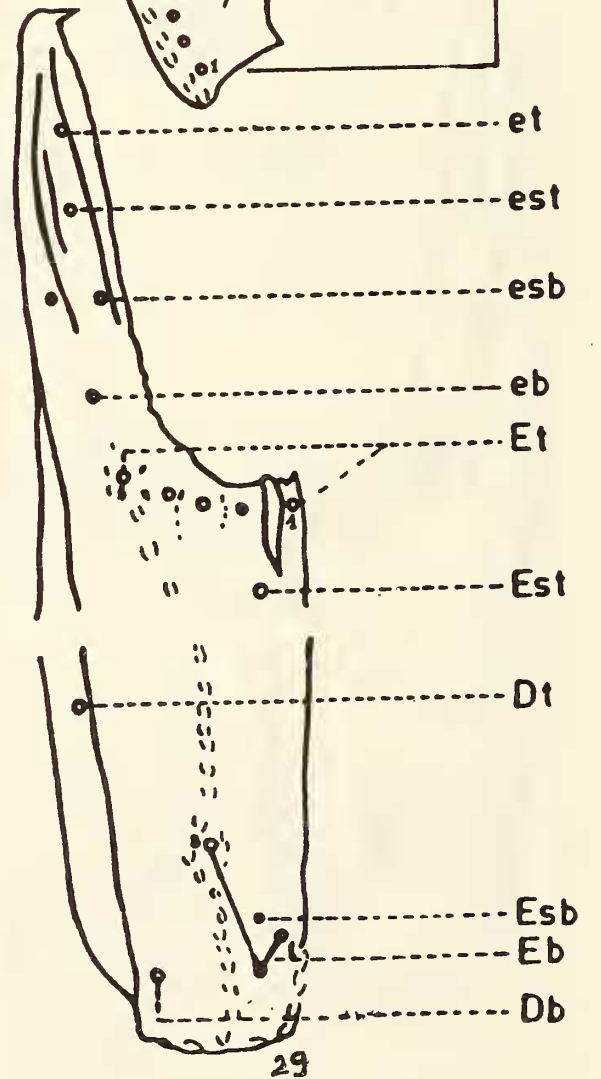
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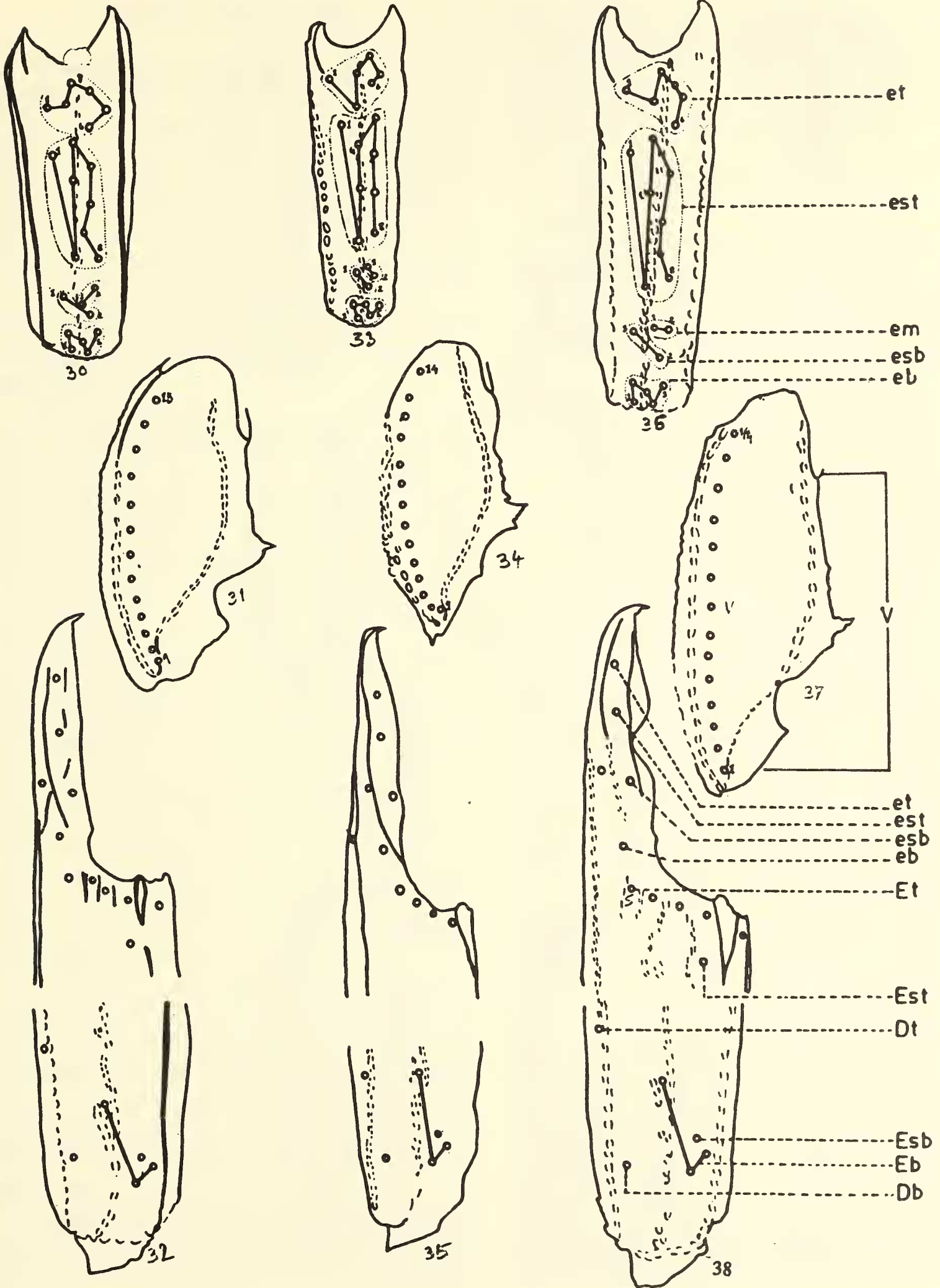
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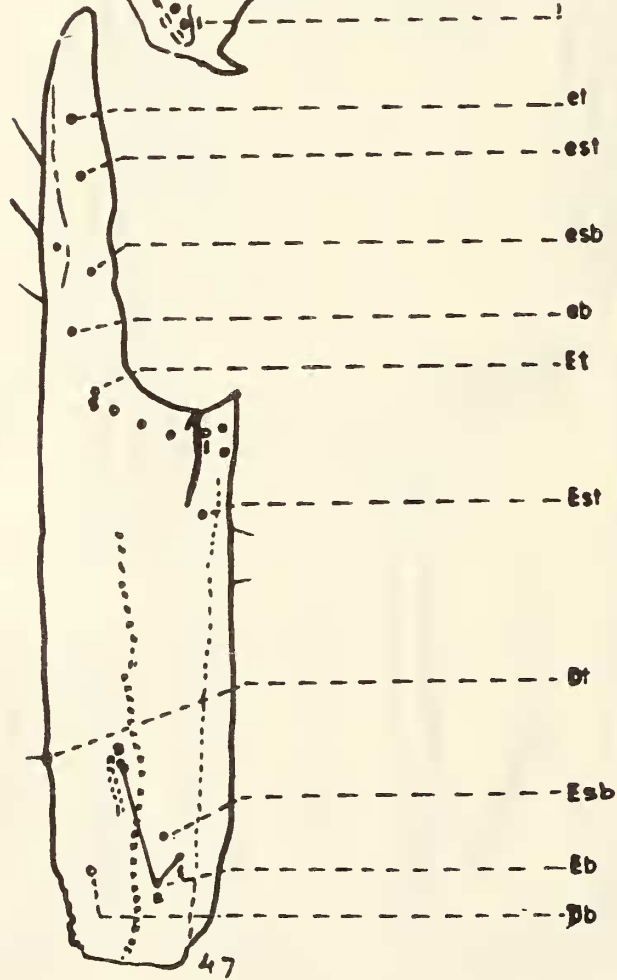
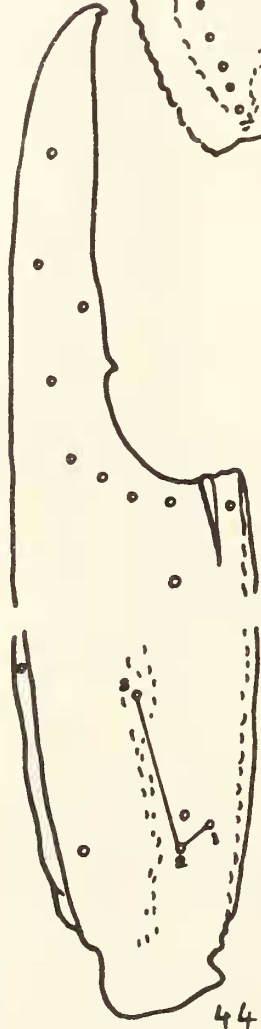
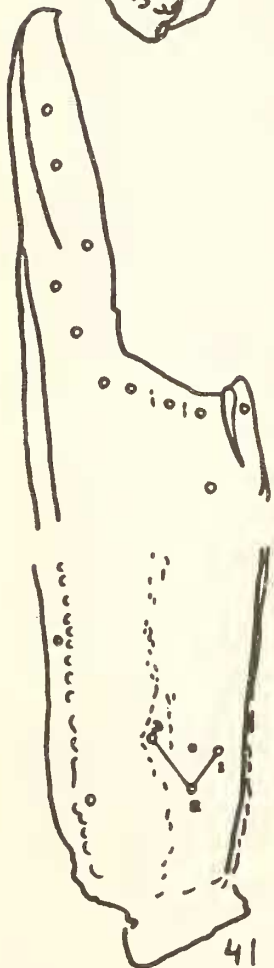
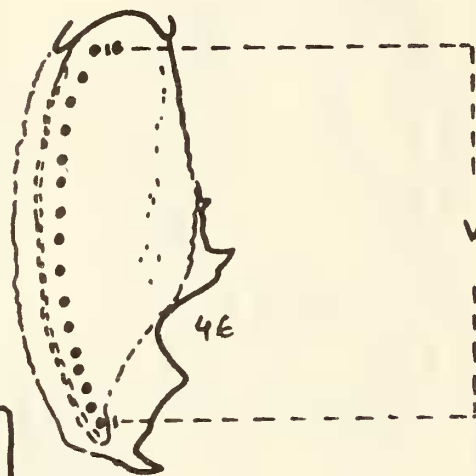
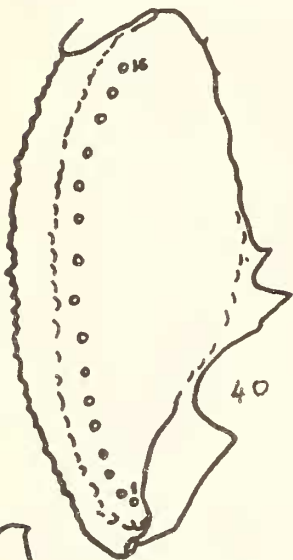
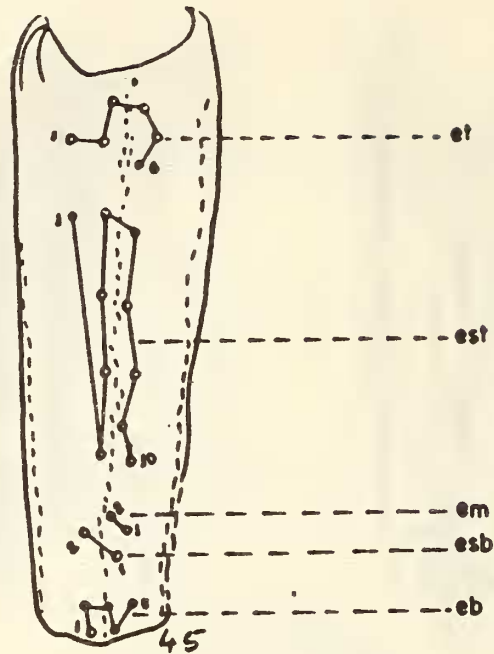
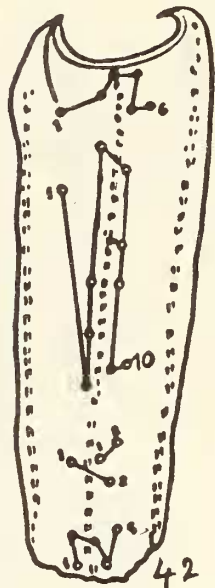
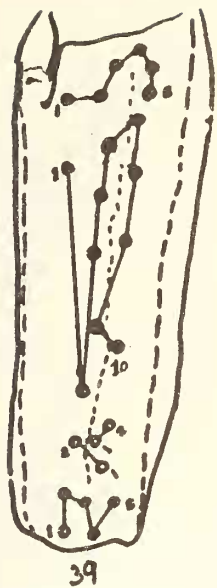


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MATERIALS AND METHODS

The hilly terrain of Western Ghats was visited and particular spots were selected to prise out the Scorpions of the sub-genus *Neoscorpions*. As these Scorpions are known to be lithophilous and rupicolous in nature, they occur more often in the cracks and crevices of the outcrops of natural hard rocks as well as in artificially cut road sides. Such rocks were located and broken carefully with the help of a flat trowel, hard and sharp crowbars. This method proved useful in getting a good yield of these Scorpions from the road side rocks, more than from natural rocks.

The specimens thus collected were directly preserved in 70% rectified spirit, precisely labelled indicating all the essential collection data, registered with Zoological Survey of India, Western Regional Station, Pune for unidentified Zoological Specimens in invertebrate section. Such specimens were studied wet under a CZ binocular for morphological as well as trichobothridial details. The studies of trichobothridial patterns on the pedipalps were compared between different forms. The diagrammatic representations were made with help of tubular camera lucida on the same binocular. The trichobothridial patterns on the external and ventral surface of the tibial segment of pedipalp and also on the manus and immovable finger of pedipalp for each specimen were studied for more details and analysed to segregate the different groups. Emphasis was given to the sets on external surface of tibia, manus and immovable finger, ventral surface of tibia and dorsal surface of manus of pedipalp.

The present communication deals with the distribution, status and variation in trichobothridial patterns among the different units of *Neoscorpions* population in Western Ghats of Maharashtra and Gujarat and also investigates the possibility of isolation within this population due to the degradation of floral components once keeping it together.

During recent surveys (1948-87) *Neoscorpions* have been collected from Mulsi (donated) and Bhimashankar, district Pune; Pandav leni, Waghera,

Dagadpada, Birdipada, Saptashringi, Hathgad, Dholapgad, Kathiwadapada and Hadakaichond, district Nasik; Jowar Mokhada, district Thane; Kondaibari Ghat, district Dhulia in Maharashtra and Ahwa in Dang district, Gujarat State.

RESULTS AND DISCUSSION

The hilly terrain of Western Ghats in Maharashtra and Gujarat shows a peculiar example of limited distribution for Scorpions of the subfamily Scorpionsinae Scorpionsidae. The distribution of this sub-family is almost restricted to some pockets in Western Ghats between Tapi Valley in the North and Koyana Valley in South (Figs. 1 & 2). It is also observed that these scorpions are distributed through hilly, comparatively humid areas and due to the heavy destruction of forests they are now inclined to be restricted to certain pockets in Western Ghats.

The detailed studies of trichobothridial patterns in the different sets on external surface of tibial digit of pedipalp viz. *eb* (1-5), *esb* (1-2), *em* (1-2), *est* (1-9) and *et* (1-7) and the ventrals (16) (Vachon 1980) show the nature of constant similarities in the composition of sets of trichobothries. Similarly, the trichobothries show some differences in the relative positions within the sets as in Figs. 3-47. The trichobothries present in the sets *eb*, *esb* and *em* (i.e. *eb* 1-5, *est* 1-2 and *em* 1-2) in the specimens studied also show the same constant numbers as those present in the species of the two other known subgenera from north and north-east India (Vachon 1980). The trichobothries present in the sets *est* and *et* show differences in respective numbers and in their placements. The ventrals (*V*) show differences in numbers only. The *Eb* and *Dt* on the manus also exhibit differences in their inter-relational placements as in text Figs. 5, 8, 11...47.

The trichobothridial patterns on tibia, manus and immovable fingers of pedipalps are considered as one of the strong and stable morphological characters to distinguish the families, genera and subgenera in Scorpions (Vachon 1973, 1975, 1980). The sub-family Scorpionsinae possesses the trichobothridial pattern of 'TYPE C' (Vachon 1973,

TABLE I
SHOWING AFFINITIES AND DIFFERENCES IN THREE SUBGENERA OF THE GENUS *SCORPIOPS* PETERS
(F: SCORPIOPSINIDAE)

Characters	Manus wider than long	Manus longer than wide	Veside wider than long	Veside longer than wide	An annular ring at the base of veside	Total No. of Trichobothria	No. of trichobothries in <i>et</i> set on tibia	No. of trichobothries in <i>est</i> set on tibia	No. of trichobothries on external medium line in <i>est</i> set	No. of V trichobothria on tibia
Names of Subgenera	1	2	3	4	5	6	7	8	9	10
<i>Scorpiops</i>	60%	40%	60%	40%	Absent	54-62	Always 4	4	Always 2	6-13
<i>Neoscorpiops</i>	00%	100%	00%	100%	Absent	67-73	Always 6	6-11	vary bet. 2-4	12-17
<i>Euscorpiops</i>	00%	100%	00%	100%	Always	55-60	Always 5	4-5	Always 2	7-9

Tikader and Bastawade 1983). The type genus *Scorpiops* Peters has been divided into four subgenera as mentioned earlier, mainly on the basis of total number of trichobothries in the sets *est*, *et*, and *v* on tibia and some other important morphological characters such as telson (Vachon 1980). Present observations further reveal that the subgenus *Neoscorpiops* (Tikader & Bastawade 1983, Figs. 1069-1128) shows more affinities to the sub-genus *Euscorpiops* (Tikader & Bastawade 1983, Figs. 1247-1305) than to the stalk sub-genus *Scorpiops* (nominal) (Tikader & Bastawade 1983, Figs. 1129-1246) See Table I.

The present observations (Figs. 3-47) allow us to suggest appropriate modifications for the trichobothriotaxy proposed by Vachon (1980) as *eb* 1-5, *esb* 1-2, *em* 1-2, *est* 1-7 to 1-10 and *et* 1-5 to 1-7 on external surface of tibia (patella) of pedipalp. His observations were based on the types of *Scorpiops* (*Neoscorpiops*) *satarensis* Pocock and *S.* (*N.*) *tenuiacauda* Pocock, probably on a few specimens. These observations are now re-examined for a larger number of *Neoscorpiops* specimens, recently collected from many new localities from Western Ghats in Maharashtra and Gujarat as mentioned earlier.

It was necessary to modify the pattern of the trichobothriotaxy presented by Vachon (1980) to *eb* 1-5, *est* 1-2, *em* 1-2, *est* 1-6 to 1-11 and *et* 1-6 (Figs. 3, 6, 9...45) (See Table II). Vachon (1980) has not mentioned *V*. (ventrals) on tibia (patella) which vary from 12 to 16 in present observations (Figs. 4-7-10...46). Trichobothria *eb* 3 placed always distal to *esb* on external surface of manus (Figs. 5-8-11...47). There seems be no relevant significance in its placement of *eb* 3 placed too close or too far away from either *esb* on external surface or to *Dt* on dorsal surface on manus (Figs. 5-8-11...47). There are always 4 *V* (ventral) trichobothries on manus (not illustrated), *db* on immovable finger always placed at the base (not shown in all the present illustrations).

Vachon (1980) discussed the nature of asymmetry and variation in trichobothridial patterns in the genus *Scorpiops* Peters. He also emphasised and synthesised the definite nature of these patterns and utilised them as one of the stronger characters in Scorpion taxonomy along with the other morphological characters as the basis. The modified trichobothridial pattern for the subgenus *Neoscorpiops* Vachon minimises the variations in the set *et* and gives scope to consider set *est* as one of the characters to be utilised for taxonomic importance

TABLE 2
SHOWING AFFINITIES AND DIFFERENCES IN THREE POPULATION UNITS OF THE SUB-GENUS
NEOSCORPIOPS VACHON (SCORPIOPS: SCORPIOSINIDAE) FROM WESTERN GHATS

Characters	Trichobothriotaxies on tibial digit of Pedipalp								Occurrence in Western Ghats	Preferential humidity
	Population Units	<i>eb</i>	<i>esb</i>	<i>em</i>	<i>est</i>	median <i>est</i> along exterior carina	<i>et</i>	<i>V</i>		
I	5	2	2	1 to 6-7	always 2	6	12-13	Lower altitude	Less humid and hot	
II	5	2	2	1 to 8-9	always 3	6	12-15	Medium altitude	Medium humid and warm	
III	5	2	2	1 to 10-11	always 4	6	15-16	Higher altitude	Much humid and cool	

along with total number of ventral (V) trichobothries on ventral surface of tibia (patella).

COMMENTS

The Western Ghats was once a continuous strip of semi-evergreen to deciduous forests (Mani 1968). Due to the enormous human activity and interference, under the name of development, much of the forest cover has now been depleted. Most of the places once under forest cover and connected through floral agencies, have now been cut off from each other, though not yet completely.

Such destructive activities have affected faunal life and created obstructions which limit the movements of fauna, specially the ground dwelling invertebrates such as Scorpions, which mostly have nocturnal life conditions and are true ground dwelling creatures. Their spatial movements within population units are basically very limited. Due to these conditions the high altitude places (peaks) of Western Ghats exhibit a typical case of formation of smaller units of suitable habitat for *Neoscorpions* population now partly and partially isolated from each other, particularly at places such as Mahabaleshwar, Sinhadgad, Matheran, Bhimashankar, Brahmagiri and Saptashringi, etc.

Subba Rao & Mitra (1979) state that "type localities for 16 species (Mollusca) recorded fall within the Pune district and the majority of them are recorded from hill streams near Khandala. All these species have a restricted range of distribution in the Western Ghats, and are not known beyond it."

Interestingly, the Scorpion subgenus *Neoscorpions* is limited to the south of Tapi Valley in the north and North of Koyana Valley in the south in Western Ghats (Map 2). As the species of to Mollusca, this Scorpion subgenus is so far unknown beyond these limits.

The genus *Scorpions* Peters in course of evolution has diverged into three separate subgenera among Indian species. The subgenus *Scorpions* Vachon retains the basic trichobothridial pattern and the numbers as in the stalk genus *Scorpions* Peters. The two other sub-genera namely *Euscorpions* Vachon and *Neoscorpions* Vachon show change in this character. The pattern, number and placements of the trichobothries, at least in two sets namely *et* and *est* have changed. The original number of trichobothries 4 *et*, 4 *est* sets in *Scorpions* Vachon have changed to 5 *et*, 4-5 *est* sets in *Euscorpions* and 6 *et*, 6-11 *est* sets in *Neoscorpions* respectively (See Table I). Such change is more prominent in the *est* set for subgenus *Neoscorpions* Vachon, which further shows some isolation trend in each unit among the existing population in Western Ghats of Maharashtra and Gujarat. The trichobothries present on the external surface of tibia (patella) in *est* set along the median external carina observed to be considerably stable in topographically isolated forms of the subgenus *Neoscorpions*. These exhibit three units having only 2 *est* trichobothries on external median carina (Fig. 3, 6 & 9), 3 *est* (Figs. 12, 15, 18, 21, 24, 27, 30, 33 & 36) and 4 *est* (Figs. 39, 42 & 45). The unit 3 *est* trichobothries seems to be more common and widely distributed than the remaining

two. These three units show morphometric differences and the distributional stratigraphy of these units might also be requiring the preferential differences, for which further studies are needed. These are in progress.

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